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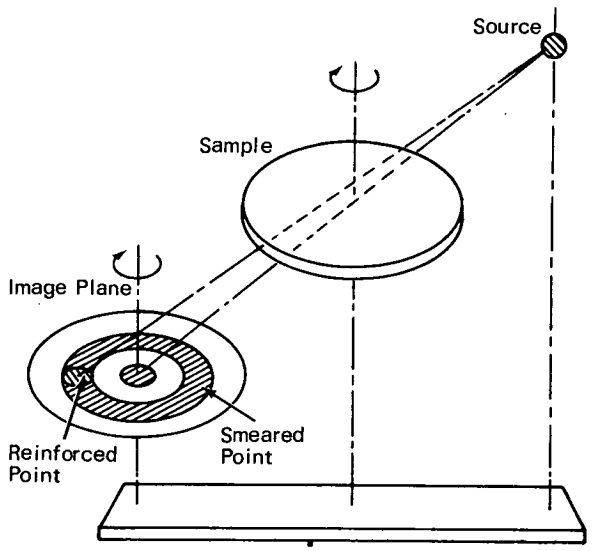
NASA TECH BRIEF

Marshall Space Flight Center

Multilayered Printed Circuit Boards Inspected by X-Ray Laminography

A new technique called laminography shows considerable promise in producing high-resolution cross-sectional radiographs, with very close interplane spacing, in the inspection of multilayer printed circuit boards to be used in the dual role of providing circuitry routing and module structural support. In such applications, the board is normally made of a laminate of several elements to depths as great as 1.27 cm (0.5 in.).



The inspection of these boards becomes particularly important where they are to be subjected to the vibration and G forces of high altitude and space missions. Previously, radiography was a prime method of inspection, but this technique cannot locate deep flaws in a sample without multiple exposures and a subsequent careful analysis by personnel with considerable skill.

The laminography technique is based on the fact that, if the sample and image-forming plane rotate synchronously, the source-(X-rays)-sample-image plane geometry will determine a plane in the sample whose image remains fixed in the rotating image-forming surface. Other planes in the sample will result in images which describe epicycles in the image-forming plane, and, therefore, no sharp image can be observed. The relatively uniform smearing of the images of planes in the sample is the essential mechanism that accounts for the operation of the technique. The figure shows a reinforced point and a smeared point after 2π rad (360°) rotation.

A prototype laminograph can inspect any printed circuit board to maximum dimensions of 30.48 by 30.48 by 1.27 cm (12 by 12 by 0.5 in.), and can provide three magnifications: 0.2X, 1.0X, and 4.0X. Resolution of the system in this mode is severely limited by the television resolution (selected as the image-forming medium in the prototype), and only gross detail can be observed. At the 1.0X magnification, reasonable detail is available, but an area of only 3.15 by 3.15 cm (1.24 by 1.24 in.) is viewed. At the 4.0X magnification, the viewed area is only 0.76 by 0.76 cm (0.3 by 0.3 in.), but the resolution approaches 0.0025 cm (0.001 in.). This small viewed area represents the most serious design compromise and was dictated by the resolution detail requirement.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

(continued overleaf)

Reference:
NASA-CR-98249 (N69-16859), Development of a Continuous Scanning Laminograph

Patent status:

No patent action is contemplated by NASA.

Source: R. B. Moler, D. L. Riley, R. C. Pape, R. Kasparas, B. E. Arneson, R. H. Hagedorn, P. C. Gregg and H. F. Bennett of IIT Research Institute under contract to Marshall Space Flight Center (MFS-20849)